DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
Proposal Submission

DARPA's charter is to help maintain U.S. technological superiority over, and to prevent technological surprise by, its potential adversaries. Thus, the DARPA goal is to pursue as many highly imaginative and innovative research ideas and concepts with potential military and dual-use applicability as the budget and other factors will allow.

DARPA has identified technical topics to which small businesses may respond in the fiscal year (FY) 2002 solicitation. Please note that these topics are UNCLASSIFIED and only UNCLASSIFIED proposals will be entertained. Although they are unclassified, the subject matter may be considered to be a "critical technology." If you plan to employ NON-U.S. Citizens in the performance of a DARPA STTR contract, please inform the Contracting Officer who is negotiating your contract. These are the only topics for which proposals will be accepted at this time. A list of the topics currently eligible for proposal submission is included followed by full topic descriptions. The topics originated from DARPA technical program managers and are directly linked to their core research and development programs.

Please note that **1 Original and 4 copies** of each proposal must be mailed or hand-carried. DARPA will **not** accept proposal submissions by electronic facsimile (fax). A checklist has been prepared to assist small business activities in responding to DARPA topics. Please use this checklist prior to mailing or hand-carrying your proposal(s) to DARPA. Do not include the checklist with your proposal.

- DARPA Phase I awards will be Firm Fixed Price contracts.
- Phase I proposals **shall not exceed $99,000,** and may range from 8 to 12 months in duration. Phase I contracts cannot be extended.
- DARPA Phase II proposals must be invited by the respective Phase I technical monitor (with the exception of Fast Track Phase II proposals – see Section 4.5 of this solicitation). Phase II STTR awards will generally be limited to $500,000. It is expected that a majority of the Phase II contracts will be Cost plus fixed Fee, however, DARPA may choose to award a Firm Fixed Price Contract or an Other Transaction, on a case-by-case basis.

Prior to receiving a contract award, the small business **MUST** be registered in the Centralized Contractor Registration (CCR) Program. You may obtain registration information by calling 1-888-352-9333 or Internet: http://www.ccr2000.com/ and https://www.ccr.dlis.dla.mil.

The responsibility for implementing DARPA's Small Business Technology Transfer (STTR) Program rests with the Contract Management Office. The DARPA SBIR/STTR Program Manager is Connie Jacobs. DARPA invites small businesses, in cooperation with a researcher from a university, an eligible contractor-operated federally funded research and development center (FFRDC), or a non-profit research institution, to send proposals directly to DARPA at the following address:

DARPA/OMO/CMO/STTR
Attention: Ms. Connie Jacobs
3701 North Fairfax Drive
Arlington, VA 22203-1714
(703) 526-4170
Home Page http://www.darpa.mil

STTR proposals submitted to DARPA will be processed by DARPA and distributed to the appropriate technical office for evaluation and action.

DARPA selects proposals for funding based on technical merit and the evaluation criteria contained in this solicitation document. DARPA gives evaluation criterion a., "The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution" (refer to section 4.2 Evaluation Criteria - Phase I - page 7), twice the weight of the other two evaluation criteria. As funding is limited, DARPA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and highly relevant to the DARPA mission. As a result, DARPA may fund more than one proposal in a specific topic area if the technical quality of the proposal(s) is deemed superior, or it may not fund any proposals in a topic area. Each proposal submitted to DARPA must have a topic number and must be responsive to only one topic.

- Cost proposals will be considered to be binding for 180 days from closing date of solicitation.
- **Successful offerors will be expected to begin work no later than 30 days after contract award.**
- For planning purposes, the contract award process is normally completed with 45 to 60 days from issuance of the selection notification letter to Phase I offerors.

The DoD STTR program has implemented a Fast Track process for STTR projects that attract matching cash from outside investors for the Phase II STTR effort, as well as for the interim effort between Phases I and II. Refer to Section 4.5 for Fast Track instructions. DARPA encourages Fast Track Applications to be submitted during the last two months of the Phase I effort. Technical dialogue with DARPA Program Managers is encouraged to ensure research continuity during the interim period and Phase II. If a Phase II contract is awarded under the Fast Track program, the amount of the interim funding will be deducted from the Phase II award amount. It is expected that interim funding will not exceed $40,000.

To encourage the transition of STTR research into DoD Systems, DARPA has implemented a Phase II Enhancement policy. Under this policy DARPA will provide a Phase II company with additional Phase II STTR funding, not to exceed $150K, if a DARPA Program Manager can match the additional STTR funds with DARPA core-mission funds or the company can match the money with funds from private investors. DARPA will generally provide the additional Phase II funds by modifying the Phase II contract.

TITLE INDEX TO THE DARPA FY2002 STTR TOPICS

SUBJECT/WORD INDEX TO THE DARPA FY2002 STTR TOPICS

Subject/Keyword | Topic Number

DARPA STTR FY 2002 TOPIC DESCRIPTIONS

DARPA ST021-001 TITLE: Innovative Antenna Concepts for Soldier and Field Applications

KEY TECHNOLOGY AREA: Sensors, Electronics and Battlespace Environment

OBJECTIVE: To demonstrate the feasibility of developing new antenna concepts incorporating innovative materials that can potentially be used for a variety of applications from fabric based soldier antennas to antennas that can be applied in the field to a variety of surfaces.

DESCRIPTION: Recently available materials indicate the potential for producing lightweight, rugged printable antennas on a variety of substrates. As such, some of these materials remain unproven for radio frequency (RF) applications. The objective of this SBIR is to evaluate the merits of these materials for antennas and transmission lines and to develop and demonstrate new antenna concepts based on these materials. A number of different scenarios are of interest. For instance, one possible application would be to develop a directional broadband fabric based soldier worn antenna that would be capable of being used for lower probability of intercept/lower probability of detection (LPI/LPD) communications where communications between two specific nodes are required. Other applications of interest include antennas that are lightweight, are broadband and can be rapidly deployed in the field either as stand alone units or applied to a variety of surfaces such as glass, fabric and rigid or flexible plastic.

PHASE I: Define and evaluate analytically broadband antenna concepts incorporating new and innovative materials that could be suitable for the applications described. Phase I should include an evaluation of the RF integrity of the proposed materials in terms of fatigue, creasing, launderability etc. where appropriate.

PHASE II: Based on the results of Phase I, design and fabricate several prototype antennas that can be used for a variety of applications from wearable to field deployable. Verify the performance of these antennas through laboratory and field-testing.

PHASE III DUAL USE APPLICATIONS: The antennas developed under this SBIR can be transitioned to both land and sea based Special Operations Forces, may be useful for programs such as Small Unit Operations (SUO) (please see www.darpa.mil for a description of SUO), for other DoD components requiring either wearable or fieldable antennas, and for law enforcement agencies. Potential commercial applications exist for incorporation with wearable electronics, for search and rescue personnel and for firefighters.

KEYWORDS: Antenna, Wearable, Deployable, Broadband.

REFERENCES:

1. K. Siwiak, Radiowave Propagation and Antennas for Personal Communications, Artech House, 1995.
2. P. S. Hall, "New Wideband Microstrip Antenna using Log-Periodic Technique", Electronics Letters, Vol. 16, No. 4, 14 February 1980, pp. 127-128.

DARPA ST021-002 TITLE: Active Methods for Warfighters

KEY TECHNOLOGY AREA: Human Systems; Information Systems Technology

OBJECTIVE: Demonstrate a rapid-development platform for task-specific collaborative software that can guide geographically separated warfighters through mission-critical processes. There are two specific innovative research objectives: a) to create sustainable military advantage by significantly shortening command decision and planning cycles; b) to significantly reduce the development cycle for software to support such tasks.

DESCRIPTION: There are many command tasks: situation assessment, developing Commander's Intent, Course-of-Action development, long and short-term planning, to name but a few – which require the combined information and expertise of many minds. Rapid, reliable execution of these tasks can create sustainable military advantages. Research indicates that current collaboration technologies, from Internet chat to remote map sketching to full-blown group support systems (GSS) can enhance the performance of small and constrained groups of warfighters. However, the ability to scale collaborative technologies and software to support large groups of land and sea forces facing real operational situations is constrained by a) limits on technology architectures; b) high costs for configuring and running a collection of collaborative tools; and c) a lack of expertise on how to utilize collaboration tools effectively in support of particular tasks. Task-specific collaborative applications, dubbed "co-active methods", could overcome these constrains by helping warfighters move through a series of steps for completing a planning task. At each step an active method should present warfighters with just the right set of collaborative tools configured in just the right way, with just the right on-line guidance to allow them to successfully complete the step jointly. Upon completion of a task, deliverables would be automatically routed to those who need them. It should be possible for hundreds of warfighters to use the same system simultaneously. Such a system must operate effectively in the low-speed and intermittent data channels common to warfighting situations. It must be possible for process experts (typically warfighters) to develop co-active methods without the intervention of a computer programmer. It must be possible for an active method developer to create different tool configurations for the same step for warfighters in different roles. It must be possible to arrange and configure a wide variety of collaborative tools on a given screen for a given step. The system architecture to support this process must be open so that third parties may create and integrate new tools to be included into co-active methods. System clients must be provided software that runs across heterogeneous software and hardware platforms. The system may assume that the warfighters understand the process they are to conduct, but co-active methods should require little or no technology training for the warfighters; they should be self-evident once the warfighter has joined a task. It should be possible to embed co-active methods in other software systems like maps, portals, and virtual workspaces.

PHASE I: Explore concepts, design technical architecture for co-active methods, and design an authoring environment for creation of co-active methods. Illustrate the feasibility of co-active methods (that co-active methods could be built without computer programmers and that warfighters could use them with little or no technology training) through implemented code. Identify target command processes for which co-active methods are likely to produce a high payoff. Identify which kinds of collaborative technologies should be incorporated into a full system and the kinds of cognitive processes these tools should support. Illustrate the feasibility of these concepts through implemented code.

PHASE II: Demonstrate fully functioning environments for creating and delivering co-active methods. Demonstrate fully functioning co-active methods for mission critical tasks. Develop metrics and compare the effectiveness of people using co-active methods to those using other means to learn the strengths and weaknesses of the approach.

PHASE III DUAL USE APPLICATIONS: Co-active methods can be applied to a vast array of tasks in government, the military, academia, and industry. Such tasks might include strategic planning, risk and control assessments, project management, collaborative authoring, requirements negotiation, and product development. The key is to design and implement some of these other tasks to demonstrate the technology is both affordable and scaleable.

KEYWORDS: Command Processes, Human Interaction, Collaborative Technology.

DARPA ST021-003 TITLE: Exploitation of Nonlinear Wave Phenomena in Sensing and Communication

KEY TECHNOLOGY AREAS: Sensors, Electronics and Battlespace Environment and Information Systems Technology

OBJECTIVE: Develop novel algorithmic methods for analysis and synthesis of acoustic and electromagnetic signals produced through nonlinear interactions in devices, structures, and materials. Overall goals are to enable rational design methodology for creating novel nonlinear devices and to provide for the diagnosis, location, and identification of nonlinear mechanisms in existing devices, structures and materials.

DESCRIPTION: Fundamental defense applications ranging from communications to remote sensing systems exploit the information content of acoustic electromagnetic signals and waves. In practice, both intentional and unintentional nonlinear interactions play significant and performance determining roles in the systems responsible for generation, transmission, reception, processing, and analysis of the signals. Analytic and numerical tools for understanding the detailed nature and systems level impact of these nonlinear phenomena are critically needed for a spectrum of applications ranging from controlling intermodulation distortion in novel amplifier designs to the solution of inverse scattering problems associated with surveillance problems. Present modeling and design capabilities are impeded by the high computational complexity of current models and data analysis techniques in these arenas. The goal of this research will be the development and validation of efficient new numerical and data analytic tools for empirical real time modeling of nonlinear interactions between electromagnetic or acoustic waves, and demonstration in applications of defense interest. Algorithmic developments should provide efficient generalizations of the separation of variables approach to achieve efficient decomposition of complex interaction and dimensionality reduction in representations of nonlinear devices and systems. For example, useful developments might include nonlinear generalizations of the singular value decomposition capable of providing the computational efficiency breakthroughs required for near real-time data analysis and online computation. The resulting representations should be capable of providing an effective and affordable "fingerprinting" of nonlinear effects encountered in systems of interest to the DoD.

PHASE I: Determine for analysis candidate nonlinear, coherent, and/or incoherent electromagnetic or acoustic mechanisms in defense communication or remote sensing systems. Evaluate feasibility of candidate data-driven models for these systems in terms of computational efficiency and data reduction performance. Identify potential commercial applications.

PHASE II: Design, build and test a suite of efficient analysis and synthesis algorithms capable of high finesse identification of signatures in systems identified in Phase I. Demonstrate enhanced data reduction and feature extraction by exercising prototype algorithm suite on simulated and actual data from nonlinear electronic, acoustic, or other signal sources.

PHASE III DUAL USE APPLICATIONS: Algorithms developed will be applied to commercial and military problems in design of nonlinear optical, microwave, and acoustic devices. These will have applications ranging from automatic target recognition to the design and control of amplifiers for communications.

KEYWORDS: Nonlinear Devices, Modeling and Data Processing Algorithms.

DARPA ST021-004 TITLE: Small Scale, Fast Reacting On-Demand, Propulsion Pump

KEY TECHNOLOGY AREA: Space Platforms, Weapons, and Air Platforms

OBJECTIVE: Develop a small scale, fast reacting, propellant pump that enables the storage of propellant in low pressure tanks and feeds propellant to high-pressure propulsion systems while maintaining quick response to variable and intermittent flow demands.

DESCRIPTION: Small-scale launch vehicles for space access, space based interceptors for ballistic missile defense[1], and planetary sample return missions[2] all require exceptional performance from rocket propulsion systems in terms of thrust and total impulse required. Minimizing the weight and size of engines, and their associated propellant feed hardware, is critical to the performance of rocket-propelled vehicles[3]. Operating their combustion chambers at high pressure minimizes the size and weight of rocket engines. In contrast, handling the propellants at low pressure minimizes propellant feed hardware size and weight. The spectrum of practical engineering approaches are: 1) A high pressure rocket engine fed with a pump, and 2) A medium to low pressure rocket engine fed from a pressurized propellant tank. In the first approach, the pump-fed engine approach, the engine size and weight, as well as the feed system hardware's size and weight are minimized with the utility of a pump. The propellant tankage and feed system before the pump are designed for low pressure, which implies they are designed to be lightweight. The engine is allowed to operate at high pressure because the pump boosts the pressure up to the engine's pressure. This means the engine is allowed to have optimized performance for its weight. The second approach, the pressure-fed approach, does not strive to minimize size or weight at all. This approach strives to minimize the complexity of the propulsion system through the elimination of the pump. Traditionally, all successful, high performance liquid rocket propulsion systems have implemented the pump-fed engine approach. Pressure-fed approaches have been limited to applications with less stringent performance requirements like sounding rockets and on-orbit propulsion applications. The small-scale applications identified above have not been able to implement the pump-fed engine approach because there has not been pump technology developed for this application scale. This topic hopes to develop pump technology at small scale in order to enable much higher propulsion performance options. Traditionally turbo pumps have been the pump technology used for rocket applications; however, at small-scale previous studies have shown that constant-displacement reciprocating pumps[4] have a power to weight advantage for propulsion systems below 10,000 lb_f of thrust. Constant-displacement pumps have the additional advantage of being able to react quickly to changes in flow requirements. There are a number of high performance applications that require discontinuous and unsteady operation of rocket engines. Two prominent examples are the feeding of propellant to divert thrusters of a kinetic kill vehicle in a missile defense system and the feed of propellant to the attitude control thrusters of an exo-atmospheric vehicle. Constant-displacements pumps can be made to start and stop and vary their flow with little or no variation in delivery pressure. Turbo-pumps, because they are not constant-displacement systems, can't be made to quickly start, stop, or vary their operation. Traditionally for applications that require intermittent thruster activity, only pressure-feed propulsion systems have been applied. If small-scale constant-displacement pumps technology were available, many of these small-scale, and non-steady state, applications could be designed for more optimal performance.

PHASE I: Design, develop a pump concept. During the first phase, the performer will propose a conceptual pump. Formal design of the concept will be performed and a preliminary design review and report will be generated. As part of the final report, plans for Phase II will be proposed.

PHASE II: The design from Phase I will be finalized. All appropriate engineering testing and validation of design issues will be performed. A critical design review will be performing to finalize the design and a prototype unit will be manufactured and tested.

PHASE III DUAL USE APPLICATIONS: Several units of the pump design will be manufactured and a series of qualification tests will be performed to validate the design and its performance. There is both military and commercial application of this technology in space launch, sounding rocket, and ballistic missile defense applications. This technology is also applicable to the growing interest in commercial space tourism with exo-atmospheric vehicles. The application of constant-displacement pumps could also be applied to existing pressure-fed propulsion systems[5]. In this application the pumps would replace the pressurization subsystem at a considerable weight savings, performance, and revenue gain. Commercial and military satellite systems could be extended with this technology.

KEYWORDS: Rocket, Pumps, Interceptors, Launch, Vehicle, and Propulsion.

REFERENCES:
1. Schindler, R.C., SDI Thinks Small Miniaturized Propulsion is Needed for Ground- and Space-Based Kill Vehicles, AIAA 92-1932, 1991.
2. Carter, P.H., Mitlitsky F., et.al., Design Trade Space for a Mars Ascent Vehicle for a Mars Sample Return Mission, Acta Astronautica, Vol. 45, Nos. 4-9, pp. 311-318, 1999.
3. Humble, R.W., Henry, G.N., Larson W.J., Space Propulsion Analysis and Design, McGraw-Hill, 1995.
4. Whitehead, J.C., Free Piston Pumps for Miniature Rocket Propulsion, AIAA 91-1831, 1991.
5. Whitehead, J.C., Self-Pressurizing HTP Feed Systems, UCRL-JC-136124, University of California, Lawrence Livermore National Laboratory, 1999.

DARPA ST021-005 TITLE: Air Liquefaction Heat Exchanger and Collector

KEY TECHNOLOGY AREA: Space Platforms

OBJECTIVE: Develop a practical air liquefaction heat exchanger and collector that can be integrated into existing liquid hydrogen (LOX) and liquid oxygen expander cycle rocket engines.

DESCRIPTION: Liquid air cycle rocket engine propulsion technology and its derivatives are listed among the four top priorities for detailed study in the National Research Council 1998 (Ref. 1). For forty years the performance advantages of various liquefaction air cycle engines (LACE) have been well documented and studied (Ref. 2). Recently a number of LACE concepts have been defined that can utilize existing rocket engines and turbojet engines. These concepts have the advantage of utilizing already developed and proven engines and turbo-machinery components (Ref. 3). As with all LACE concepts, liquid air is introduced into these engines with an air liquefaction heat exchanger and collector. In this heat exchanger air is chilled with liquid hydrogen until the air is liquefied. The liquid air is collected and used to supply or supplement the rocket engine's oxidizer. The hydrogen is used to drive the engine's turbo-pumps and to fuel the engine. Unfortunately, LACE concepts have not been developed, despite their advantages, because of difficulties in developing the air liquefaction heat exchanger and collector. The primary difficulties in developing a liquefaction heat exchanger are: 1) Icing from atmospheric water in the lower atmosphere, 2) Vulnerability to damage from ingestion of foreign objects in flight, and 3) weight. Recent advancements in micro channel heat exchangers and platelet manufacturing techniques promise to enable the design of air liquefaction heat exchangers and collectors that are lightweight and durable. Also several strategies have been developed for avoiding icing at lower altitude. The simplest approach is to just limit LACE operation to higher altitudes; however, various methods of LOX injection, alcohol injection and hot/cold cyclic operations have been demonstrated to control the icing problem. The objective of this SBIR topic is to develop a practical air liquefaction heat exchanger and collector to enable the development of a wide range of LACE based engine concepts.

PHASE I: The proposed heat exchanger/collector design will be analyzed in detail. It is desired that a proof-of-principal element will be manufactured to demonstrate that the design can be manufactured. The predicted heat exchanger performance will also be demonstrated with this proof-of-principal element.

PHASE II: Design and size an air liquefaction heat exchanger and collector to supplement liquid air to an RL-10 liquid hydrogen/liquid oxygen expander cycle rocket engine at a liquid-air-to-liquid hydrogen ratio of two. This design need not be designed for flight, or integration, on a RL-10, but must demonstrate the heat exchanger performance and ability to collect liquefied air.

PHASE III DUAL USE APPLICATIONS: Both commercial and military space launch systems can benefit directly from the development of this technology. If this technology is applied to existing rocket engines, like the RL-10, a launch system could see a 20% improvement in specified impulse. This technology can also be applied to high-speed, long-range, rapid response military aircraft. If this technology is applied to a new engine concept, that is designed to take more optimal advantage of LACE, the resulting performance could enable lower cost single stage to orbit launch vehicles.

KEYWORDS: Liquefaction, Liquid Air, Liquid Hydrogen, Expander Cycle Rocket Engine, Heat Exchanger.

REFERENCES:
1. Maintaining U.S. Leadership in Aeronautics. Breakthrough technologies to Meet Future Air and Space Transportation Needs and Goals, National Research Council, National Academy Press, Washington, D.C., 1998.
2. Escher, W.J.D., and Flornes, B. J., et al, A Study of Composite Propulsion Systems for Advanced Launch Vehicle Applications, Final Report on NASA Contract NAS7-377, The Marquardt Corporation, Van Nuys, CA, April 1967.
3. V. Balepin, P. Hendrick, Lightweight Low Cost KLIN Cycle Derivative for a Small Reusable Launcher, AIAA-99-4893, 1999.

DARPA ST021-006 TITLE: Flash Capture A/D

KEY TECHNOLOGY AREA: Information Systems Technology

OBJECTIVE: Develop analog-to-digital (A/D) converters, which are low power and can capture a pulse at wide bandwidths for short time durations.

DESCRIPTION: 1) Motivation: The development of A/D technology has been much slower than the development of very large-scale integration (VLSI) devices. The growth per bit has been roughly 1 per 18 months as opposed to doubling of transistor densities as governed by Moore's law. 2) Technology survey: The current state-of-the-art in A/D technology is the MAX108 flash A/D [1] that can digitize at sample rates up to 1.5 Billion Giga-Samples Per Second (GSPS), digitizing bandwidth up to 750MHz with 7.5 effective bits (SNR ~ 48 dB) dissipating 5.25W with heatsink and 200 LFM airflow. The A/D chip includes a Track/Hold (T/H) amplifier and quantizer and is based on bipolar process technology and is $495 in 1,000-piece lots. Analog Devices also has high-speed wideband A/Ds [2]. The AD9430 is a biCMOS device with 210 Mega-Samples Per Second (MSPS), digitizing bandwidth up to 65MHz with

10.3 effective bits dissipating 1 to 2 W. National Semiconductor is also a leading supplier of A/Ds [3]. The ADC08200 is their current state-of-the-art A/D with 200 MSPS and 7.3 effective bits dissipating 230mW and priced at $10.50 in 1,000-piece lots. Clearly, the Maxim MAX108 flash A/D is currently the fastest wideband A/D on the commercial market but it is also one of the highest in power consumption. Each of these commercial vendors has a number of low power CMOS or biCMOS based A/Ds. Typical characteristics associated with CMOS based A/Ds are 1.5V, 10-bit, 10 to 15 MSPS, and ~ 50 to 100's of mW of power dissipation at a cost of $8 to $10 in lots of 1,000. There are also multiple research efforts [4] [5] focusing on CMOS based A/D technology that addresses integration of A/D functionality with CMOS circuitry such as Digital Signal Processors (DSP). The typical characteristics associated with these efforts are similar with the focus addressing A/Ds based on the operating voltage of that utilized in the CMOS circuit technology. Researchers are attempting to address CMOS technology trends of decreasing line sizes and associated decreases in the power supply voltage, Voltage Drain Drain (Vdd). Forecasts for Vdd over the next 10 years by the Semiconductor Industry Association show incremental steps down from a current 1.5V to 0.6V in 2012 [4] [6]. These research efforts are mainly focused on sigma-delta or pipeline A/D architectures that use multiple stages and code words to generate the number of desired output bits. Other approaches use threshold logic gates to generate outputs of a few bits (<5). Threshold logic gates will be more difficult to build as Vdd decreases over time. Typical applications for CMOS based A/Ds include camcorders, digital set-top boxes, and wireless local area networks transceivers. In comparison, the current state-of-the-art A/D chip is intended for direct radio frequency (RF) down conversion, digital oscilloscopes, and high-speed data acquisition. These are high-speed applications where power is not a first order design issue. 3) Research Direction: In some applications, it is sufficient to grab a short pulse of samples. As a motivation consider data calibration or interference cancellation where only a small collection of data is required, but must be obtained at low cost and power since all elements in a phased array must be accessed. A typical power and bandwidth goal might be 20mW and 1GHz of bandwidth, with a few thousands samples, at 10-12bits. Clearly, the current state-of-the-art does not address the low power and number of bits while the research efforts do not address 1 GHz of bandwidth. A combination of these technologies is required and a program to demonstrate an A/D capable of this type of application could be done in multiple phases.

PHASE I: Determine the system on a chip (SOC) architecture and do board level demonstrations, technology may include, for example, charge coupled devices (CCDs).

PHASE II: Design and build a full system-on-a-chip.

PHASE III DUAL USE APPLICATIONS: Improved resolution digital cameras and other commercial items.

KEYWORDS: Analog-to-Digital Converter, Charge Coupled Devices.

REFERENCES:

1. Maxim Integrated Products. (2001). Products index [Online]. Available WWW: http://www.maxim-ic.com/.
2. Analog Devices Incorporated. (2001). Products index [Online]. Available WWW: http://www.analog.com/.
3. National Semiconductor. (2001). Products index [Online]. Available WWW: http://www.national.com/.
4. A. M. Abo and P. R. Gray, " A 1.5-V, 10-bit, 14.3-MS/s CMOS Pipeline Analog-to-Digital Converter," *IEEE J. Solid-State Circuits*, vol. 34, pp. 599-606, May 1999.
5. A. Schmid, D. Bowler, R. Baumgarter, and Y. Leblebici, " A Noval Analog-Digital Flash Converter Architecture Based on Capacitive Threshold Gates," ISCAS 99: 1999 IEEE International Symposium on Circuits and Systems, Orlando FL, USA.
6. Semiconductor Industry Association**.** The National Technology Roadmap for Semiconductors. {Online]. Available WWW: http://www.semitech.org/.